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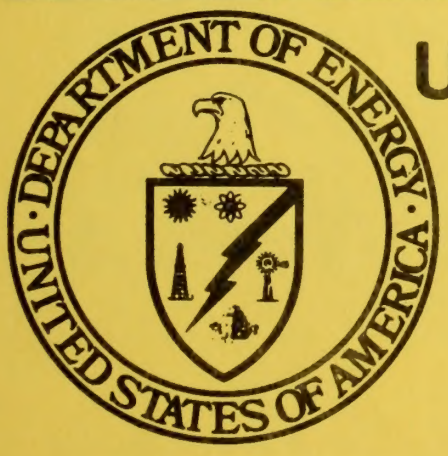
SOLAR/1056-79/01

Monthly Performance Report

M. F. SMITH ASSOCIATES

JANUARY 1979



U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT

M. F. SMITH ASSOCIATES

JANUARY 1979

I. SYSTEM DESCRIPTION

M. F. Smith Associates is a single-family residence in Jamestown, Rhode Island. The home has approximately 2240 square feet of conditioned space. Solar energy is used for space heating the home and preheating domestic hot water (DHW). The solar energy system has an array of flat-plate collectors with a gross area of 512 square feet. The array faces 15 degrees west of south at an angle of 45 degrees to the horizontal. Water is the transfer medium that delivers solar energy from the collector array to storage and to the space heating and hot water loads. Solar energy is stored in a 3150-gallon concrete storage tank. City water is preheated in storage and in heat exchanger HW1, which receives energy from a coil at the output of the heat pump compressor. Preheated water is supplied, on demand, to a conventional 82-gallon DHW tank. Solar-heated water from the storage tank is directed to a heat pump or to an hydronic heat exchanger to provide space heating. When the storage water temperature is insufficient to satisfy the heat pump input requirements, an electrical heating element (booster unit HR1) in the line between storage and the heat pump provides auxiliary energy. During the cooling season, heat is removed from the conditioned space and discharged into storage, which should be maintained below 100°F by operating the collector system at night. An electrical heating element in the DHW tank provides auxiliary energy for water heating. The system, shown schematically in Figure 1, has three modes of solar operation.

Mode 1 - Collector-to-Storage: This mode activates when the temperature difference between the collectors and the bottom of storage is 20°F or higher. Pumps P1 and P2 circulate water from the storage tank through the collectors and back. Circulation continues until the temperature difference between the collector and storage falls to 5°F or less. If the temperature in a collector panel reaches 45°F, the collector array drains down.

Mode 2 - Storage-to-Space Heating: This mode activates when the manually set thermostat in the conditioned space zones 1 and 2 indicates a demand for heat. Pump P3 circulates water from storage to the heat pump in the energy conservation module (ECM). If the input water temperature is higher than 90°F, the water will be diverted to an hydronic heating coil. If the water temperature is less than 90°F, the water will be diverted to the heat pump.

Mode 3 - DHW Preheating: This mode activates when city water enters a heat exchanger in the storage tank and flows to the HW1 preheater which receives energy from a coil at the output of the heat pump compressor inside the ECM. When there is no draw, the ECM internal pump circulates hot water from HW2 to HW1, as long as HW1 remains hotter than HW2. If a draw occurs, water flows from HW1 to HW2 for a final temperature boost.

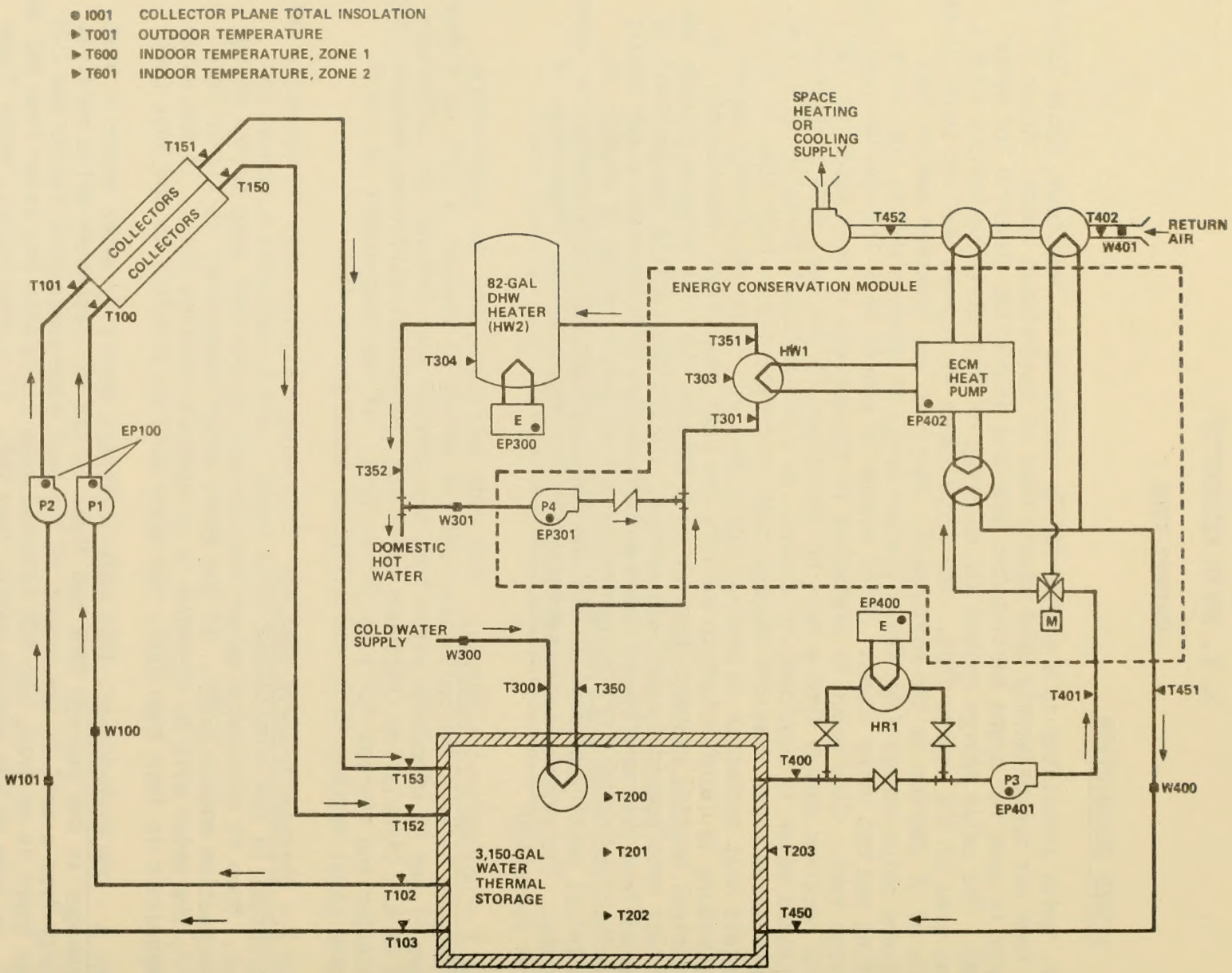

Figure 1. M. F. SMITH SOLAR ENERGY SYSTEM SCHEMATIC

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was unoccupied in January, however; the solar energy system operated continuously during the month. Solar energy satisfied 68 percent of the space heating requirements. There were no DHW requirements. The solar energy system provided electrical energy savings of 1.0 million Btu. The drain-down control system was such that on several occasions the collector flow bypassed the collectors through the drain-down solenoid valves (located in parallel with the collectors). The energy collected could not be accurately determined due to the placement of collector loop flowmeters relative to the drain-down solenoid valves. The value used for solar energy collected is the amount of energy delivered to storage from the collector array.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 13.7 million Btu for a daily average of 862 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during January of 992 Btu per square foot for a plane facing 15 degrees west of south with a tilt of 45 degrees to the horizontal. The average ambient temperature during January was 32°F as compared with the long-term average for January of 30°F. The number of heating degree-days for the month (based on a 65°F reference) was 1029, as compared with the long-term average of 1091.

THERMAL PERFORMANCE

Collector - The total incident solar radiation on the collector array for the month of January was 13.7 million Btu. During the period the collector loop was operating, the total insolation amounted to 12.0 million Btu. The total collected solar energy for the month of January was 4.7 million Btu, resulting in a collector array efficiency of 34 percent, based on total incident insolation. Operating energy required by the collector loop was 0.13 million Btu.

Storage - The amount of solar energy delivered to storage was 4.7 million Btu. There were 6.5 million Btu delivered from storage to the space heating subsystem. During January there was a storage energy gain attributed to the uninsulated storage tank located in the warmer surroundings of the dwelling. The average storage temperature for the month was 46°F.

DHW Load - There was no DHW load during the month.

Space Heating Load - The space heating subsystem consumed 6.5 million Btu of solar energy and 3.1 million Btu of auxiliary electrical energy to satisfy a space heating load of 9.6 million Btu. The solar fraction of this load was 67 percent. The space heating subsystem consumed a total of 2.3 million Btu of operating energy, resulting in an electrical energy savings of 1.1 million Btu.

OBSERVATIONS

The demand for space heating during January was satisfied by diverting storage water to the heat pump. The average temperature of this water was 46°F. There was heat pump activity during each hour in January in order to maintain the 65°F average building temperature in the 32°F average ambient temperature. The booster unit HR1 did not come on during January. The input water temperature to the heat pump was as low as 40°F for a few days during the month.

On most days, after initiation of collector loop operation there were indications that the collector flow was shunting the collectors. This condition is believed to be caused by problems with the drain-down freeze-protection control system which occasionally allows the drain-down solenoid valves (located in parallel with the collectors) to be open during periods of collector loop operation.

ENERGY SAVINGS

The solar energy system provided a net electrical energy savings of 0.96 million Btu. The space heating subsystem contributed an electrical energy savings of 1.1 million Btu.

III. ACTION STATUS

The grantee is expected to investigate the drain-down freeze-protection control problem.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND — SOLAR/1056-79/01
REPORT PERIOD: JANUARY,1979

SITE/SYSTEM DESCRIPTION:
THE M.F. SMITH SOLAR ENERGY SYSTEM PROVIDES SPACE HEATING AND DOMESTIC HOT WATER. THE SYSTEM USES WATER AS THE ENERGY COLLECTION, TRANSFER AND STORAGE MEDIUM. SOLAR HEATED WATER FROM THE STORAGE TANK IS DIRECTED TO A HEAT PUMP EXCHANGER TO PROVIDE SPACE HEATING. AN ELECTRIC BOILER PROVIDES AUXILIARY HOT WATER AS REQUIRED. MAKE-UP WATER FOR THE DHW SYSTEM PASSES THROUGH A HEAT EXCHANGER IN THE STORAGE TANK AND THEN TO A PRE-HEAT TANK. THE SOLAR HEATED WATER IS TRANSFERRED TO THE ELECTRIC HOT WATER TANK AS REQUIRED.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	13.688	MILLION BTU
	26735	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	4.714	MILLION BTU
	*	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	32	DEGREES F
AVERAGE BUILDING TEMPERATURE	65	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.47	
ECSS OPERATING ENERGY	0.132	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	2.409	MILLION BTU
TOTAL ENERGY CONSUMED	10.267	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL	
LOAD	0.000	9.639	N.A.	9.639	MILLION BTU
SOLAR FRACTION	50	67	N.A.	67	PERCENT
SOLAR ENERGY USED	-0.000	6.496	N.A.	6.495	MILLION BTU
OPERATING ENERGY	0.000	2.277	N.A.	2.409	MILLION BTU
AUX. THERMAL ENERGY	0.000	3.144	N.A.	3.144	MILLION BTU
AUX. ELECTRIC FUEL	0.000	3.144	N.A.	3.144	MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A.	MILLION BTU
ELECTRICAL SAVINGS	-0.000	1.090	N.A.	0.958	MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A.	MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.521

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND — SOLAR/1056-79/01
REPORT PERIOD: JANUARY,1979

SITE/SYSTEM DESCRIPTION:
THE M.F. SMITH SOLAR ENERGY SYSTEM PROVIDES SPACE HEATING AND DOMESTIC HOT WATER. THE SYSTEM USES WATER AS THE ENERGY COLLECTION, TRANSFER AND STORAGE MEDIUM. SOLAR HEATED WATER FROM THE STORAGE TANK IS DIRECTED TO A HEAT PUMP EXCHANGER TO PROVIDE SPACE HEATING. AN ELECTRIC BOILER PROVIDES AUXILIARY HOT WATER AS REQUIRED. MAKE-UP WATER FOR THE DHW SYSTEM PASSES THROUGH A HEAT EXCHANGER IN THE STORAGE TANK AND THEN TO A PRE-HEAT TANK. THE SOLAR HEATED WATER IS TRANSFERRED TO THE ELECTRIC HOT WATER TANK AS REQUIRED.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	14.441 GIGA JOULES
	303598 KJ/SQ.M.
COLLECTED SOLAR ENERGY	4.974 GIGA JOULES
	* KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	-0 DEGREES C
AVERAGE BUILDING TEMPERATURE	18 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.47
ECSS OPERATING ENERGY	0.139 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	2.541 GIGA JOULES
TOTAL ENERGY CONSUMED	10.832 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.000	10.169	N.A.	10.170 GIGA JOULES
SOLAR FRACTION	50	67	N.A.	67 PERCENT
SOLAR ENERGY USED	-0.000	6.853	N.A.	6.853 GIGA JOULES
OPERATING ENERGY	0.000	2.402	N.A.	2.541 GIGA JOULES
AUX. THERMAL ENG	0.000	3.316	N.A.	3.316 GIGA JOULES
AUX. ELECTRIC FUEL	0.000	3.316	N.A.	3.316 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	-0.000	1.150	N.A.	1.011 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.521

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
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REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND
REPORT PERIOD: JANUARY,1979

SOLAR/1056-79/01

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.069	49	0.176	N	0.000	N	2.364
2	0.071	52	0.160	O	0.000	O	2.099
3	0.905	26	0.260	T	0.007	T	0.286
4	0.637	18	0.309		0.006		0.496
5	0.769	22	0.186	A	0.007	A	0.333
6	0.209	27	0.178	P	0.002	P	1.056
7	0.071	36	0.081	P	0.000	P	2.398
8	0.067	45	0.049	L	0.001	L	1.802
9	0.932	27	0.153	I	0.008	I	0.225
10	0.852	23	0.206	C	0.007	C	0.317
11	0.921	19	0.298	A	0.007	A	0.353
12	0.584	19	0.339	B	0.005	B	0.555
13	0.065	34	0.181	L	0.000	L	3.259
14	0.067	39	0.086	E	0.000	E	2.442
15	0.916	25	0.168		0.008		0.256
16	0.595	28	0.191		0.006		0.432
17	0.204	24	0.132		0.003		1.075
18	0.269	22	0.089		0.004		0.727
19	1.120	14	0.164		0.007		0.229
20	0.312	24	0.125		0.004		0.731
21	0.052	44	0.077		0.000		2.968
22	0.151	36	0.054		0.003		0.901
23	0.991	33	0.109		0.009		0.191
24	0.134	35	0.153		0.000		1.513
25	0.081	41	0.078		0.002		1.912
26	0.085	36	0.065		0.008		1.623
27	0.479	40	0.098		0.005		0.366
28	0.177	39	0.063		0.004		0.776
29	0.612	39	0.167		0.005		0.360
30	0.281	36	0.132		0.003		0.765
31	1.011	33	0.193		0.009		0.221
SUM	13.688	-	4.720	N.A.	0.132	N.A.	-
AVG	0.442	32	0.152	N.A.	0.004	N.A.	0.475
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
â DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND SOLAR/1056-79/01
REPORT PERIOD: JANUARY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.069	0.020	0.000	51	0.000
2	0.071	0.015	0.000	53	0.000
3	0.905	0.843	0.318	26	0.352
4	0.637	0.595	0.216	*	0.339
5	0.769	0.711	0.297	26	0.386
6	0.209	0.101	0.014	30	0.069
7	0.071	0.019	0.000	35	0.000
8	0.067	0.024	0.011	47	0.157
9	0.932	0.881	0.367	29	0.394
10	0.852	0.789	0.319	27	0.374
11	0.921	0.871	0.347	23	0.377
12	0.584	0.507	0.208	21	0.356
13	0.065	0.012	0.000	35	0.000
14	0.067	0.018	0.000	43	0.000
15	0.916	0.868	0.341	27	0.372
16	0.595	0.551	0.232	34	0.390
17	0.204	0.147	0.029	25	0.143
18	0.269	0.201	0.116	*	0.431
19	1.120	1.054	0.332	18	0.296
20	0.312	0.257	0.090	28	0.289
21	0.052	0.013	0.000	52	0.000
22	0.151	0.090	0.023	36	0.152
23	0.991	0.960	0.428	39	0.432
24	0.134	0.028	0.000	38	0.000
25	0.081	0.032	0.018	44	0.227
26	0.085	0.059	0.015	36	0.181
27	0.479	0.436	0.179	45	0.374
28	0.177	0.137	0.055	39	0.314
29	0.612	0.544	0.242	42	0.395
30	0.281	0.204	0.079	39	0.281
31	1.011	0.973	0.439	38	0.435
SUM	13.688	11.964	4.714	-	-
AVG	0.442	0.386	0.152	35	0.344
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COCLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND SOLAR/1056-79/01
REPORT PERIOD: JANUARY,1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.000	0.164	-0.103	51	1.000
2	0.000	0.148	-0.070	48	1.000
3	0.318	0.259	0.081	50	1.067
4	0.216	0.316	-0.030	50	1.322
5	0.297	0.256	0.066	50	1.084
6	0.014	0.221	-0.138	49	5.739
7	0.000	0.171	-0.078	45	1.000
8	0.011	0.121	-0.039	43	7.767
9	0.367	0.209	0.182	46	1.067
10	0.319	0.270	0.062	50	1.044
11	0.347	0.325	0.035	52	1.038
12	0.208	0.324	-0.079	51	1.178
13	0.000	0.212	-0.127	47	1.000
14	0.000	0.163	-0.069	43	1.000
15	0.341	0.235	0.125	45	1.056
16	0.232	0.257	0.012	47	1.159
17	0.029	0.220	-0.115	45	3.600
18	0.116	0.195	0.012	43	1.787
19	0.332	0.257	0.088	46	1.038
20	0.090	0.228	-0.083	45	1.615
21	0.000	0.154	-0.062	42	1.000
22	0.023	0.136	-0.034	40	4.461
23	0.428	0.189	0.241	45	1.006
24	0.000	0.202	-0.132	46	1.000
25	0.018	0.155	-0.056	43	5.402
26	0.015	0.138	-0.046	41	5.993
27	0.179	0.175	0.078	42	1.414
28	0.055	0.137	-0.020	43	2.102
29	0.242	0.220	0.069	44	1.199
30	0.079	0.215	-0.056	44	2.016
31	0.439	0.223	0.209	48	0.985
SUM	4.714	6.495	-0.075	-	-
AVG	0.152	0.210	-0.002	46	1.362
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND
REPORT PERIOD: JANUARY,1979

SOLAR/1056-79/01

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	CPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.000	0	0.000	0.000	0.000	0.000	N	0.000	N	60	140	0
2	0.000	50	-0.000	0.000	0.000	0.000	O	-0.000	O	60	140	0
3	0.000	0	0.000	0.000	0.000	0.000	T	0.000	T	60	140	0
4	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
5	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	60	140	0
6	0.000	50	-0.000	0.000	0.000	0.000	P	-0.000	P	60	140	0
7	0.000	0	0.000	0.000	0.000	0.000	P	0.000	P	60	140	0
8	0.000	0	0.000	0.000	0.000	0.000	L	0.000	L	60	140	0
9	0.000	0	0.000	0.000	0.000	0.000	I	0.000	I	60	140	0
10	0.000	0	0.000	0.000	0.000	0.000	C	0.000	C	60	140	0
11	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	60	140	0
12	0.000	0	0.000	0.000	0.000	0.000	B	0.000	B	60	140	0
13	0.000	0	0.000	0.000	0.000	0.000	L	0.000	L	60	140	0
14	0.000	0	0.000	0.000	0.000	0.000	E	0.000	E	60	140	0
15	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
16	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
17	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
18	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
19	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
20	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
21	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
22	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
23	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
24	0.000	50	-0.000	0.000	0.000	0.000		-0.000		60	140	0
25	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
26	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
27	0.000	50	-0.000	0.000	0.000	0.000		-0.000		60	140	0
28	0.000	50	-0.000	0.000	0.000	0.000		-0.000		60	140	0
29	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
30	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
31	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
SUM	0.000	-	-0.000	0.000	0.000	0.000	N.A.	-0.000	N.A.	-	-	1
AVG	0.000	50	-0.000	0.000	0.000	0.000	N.A.	-0.000	N.A.	60	140	0
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND
REPORT PERIOD: JANUARY,1979

SOLAR/1056-79/01

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.229	72	0.164	0.040	0.065	0.065	N	0.066	N	69	49
2	0.211	70	0.148	0.042	0.063	0.063	O	0.057	O	69	52
3	0.346	75	0.259	0.060	0.088	0.088	T	0.098	T	67	26
4	0.425	74	0.316	0.080	0.109	0.109		0.112		66	18
5	0.340	75	0.256	0.065	0.084	0.084	A	0.058	A	65	22
6	0.300	74	0.221	0.065	0.079	0.079	P	0.054	P	65	27
7	0.254	67	0.171	0.074	0.083	0.083	P	0.000	P	64	36
8	0.190	63	0.121	0.063	0.070	0.070	L	-0.009	L	65	45
9	0.303	69	0.209	0.069	0.094	0.094	I	0.038	I	65	27
10	0.359	75	0.270	0.067	0.089	0.089	C	0.066	C	65	23
11	0.427	76	0.325	0.071	0.102	0.102	A	0.111	A	65	19
12	0.435	74	0.324	0.073	0.111	0.111	B	0.130	B	65	19
13	0.311	68	0.212	0.070	0.098	0.098	L	0.051	L	65	34
14	0.268	61	0.163	0.078	0.104	0.104	E	-0.001	E	65	39
15	0.348	68	0.235	0.079	0.113	0.113		0.039		63	25
16	0.366	70	0.257	0.077	0.109	0.109		0.053		64	28
17	0.344	64	0.220	0.084	0.125	0.125		0.018		64	24
18	0.321	61	0.195	0.085	0.126	0.126		-0.005		59	22
19	0.385	67	0.257	0.086	0.128	0.128		0.033		50	14
20	0.357	64	0.228	0.086	0.129	0.129		0.013		61	24
21	0.259	60	0.154	0.077	0.105	0.105		-0.006		65	44
22	0.255	53	0.136	0.084	0.119	0.119		-0.022		65	36
23	0.276	68	0.189	0.071	0.087	0.087		0.015		65	33
24	0.299	68	0.202	0.073	0.096	0.096		0.036		66	35
25	0.252	61	0.155	0.073	0.097	0.097		-0.002		66	41
26	0.257	54	0.138	0.084	0.119	0.119		-0.016		66	36
27	0.300	58	0.175	0.085	0.125	0.125		-0.000		65	40
28	0.217	63	0.137	0.076	0.080	0.080		-0.009		66	39
29	0.339	65	0.220	0.082	0.118	0.118		0.037		66	39
30	0.344	62	0.215	0.087	0.129	0.129		0.016		64	36
31	0.321	70	0.223	0.069	0.097	0.097		0.057		65	33
SUM	9.639	-	6.496	2.277	3.144	3.144	N.A.	1.090	N.A.	-	-
AVG	0.311	67	0.210	0.073	0.101	0.101	N.A.	0.035	N.A.	65	32
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND
REPORT PERIOD: JANUARY,1979

SOLAR/1056-79/01

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	135	N	49	51	N	N	N
2	138	O	52	53	O	O	O
3	1767	T	26	26	T	T	T
4	1245		18	*			
5	1503	A	22	26	A	A	A
6	409	P	27	30	P	P	P
7	139	P	36	35	P	P	P
8	131	L	45	47	L	L	L
9	1821	I	27	29	I	I	I
10	1664	C	23	27	C	C	C
11	1800	A	19	23	A	A	A
12	1140	B	19	21	B	B	B
13	127	L	34	35	L	L	L
14	131	E	39	43	E	E	E
15	1789		25	27			
16	1161		28	34			
17	399		24	25			
18	525		22	*			
19	2188		14	18			
20	610		24	28			
21	101		44	52			
22	295		36	36			
23	1935		33	39			
24	261		35	38			
25	158		41	44			
26	166		36	36			
27	935		40	45			
28	345		39	39			
29	1195		39	42			
30	549		36	39			
31	1974		33	38			
SUM	26735	N.A.	-	-	-	-	-
AVG	862	N.A.	32	35	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

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